pods, and Vertebrates the cephalic and body parts of the animal are to be regarded as directly equivalent, because they originate in an absolutely similar manner.

This is not the place to draw the conclusions which naturally follow from the above considerations; for these I must refer the reader to my more complete work, which will appear in the next volume of the 'Arbeiten aus dem zoologisch-zootomischen Institut in Würzburg.'

Würzburg, January 20, 1876.

BIBLIOGRAPHICAL NOTICE.

Catalogue of the Fossil Reptilia of South Africa in the Collection of the British Museum. By Richard Owen, C.B., F.R.S. 4to. London: Printed by Order of the Trustees, 1876.

In this work the Author has completed another of the series of 'Descriptive and Illustrated Catalogues' by which, as in the case of Hunter's 'Physiological Series in the Museum of the College of Surgeons,' he has made available to students and applicable to the advancement of science collections in our Public Museums.

The subject of the present Catalogue, in quarto, illustrated by 70 plates, is a series of fossils from South Africa, now arranged and exhibited in the Geological Department of the British Museum.

It appears that comparatively few of these evidences of the cold-blooded air-breathing Class could be brought within the limits of previously characterized Orders; and they have consequently led to the definition of new ones.

The order *Theriodontia* is characterized as follows:—"Dentition of the carnivorous type; incisors defined by position, and divided from molars by a large laniariform canine on each side of both upper and lower jaws, the lower canine crossing in front of the upper, as in Mammalia" (p. 15). Of this order twenty-two specimens are described, and referred to fourteen species representing ten genera, which are grouped, according to characters of the external nostril, into the families *Binarialia*, *Mononarialia*, and *Tectinarialia*. The type genera of this order are *Lycosaurus*, *Tigrisuchus*, *Cynochampsa*, *Nythosaurus*, *Scaloposaurus*, *Procolophon*, and *Gorgonops*.

The order *Anomodontia* is characterized by:—"Teeth wanting or limited to a single pair, having the form and proportion of tusks, or several and small, but limited to the bony palate and to the inner part of the mandibular alveolar border. The first two families, defined by dental characters, also yield the following ordinal ones, viz.:—a 'foramen parietale;' two external nostrils; tympanic pedicle fixed; vertebræ biconcave; anterior trunk-ribs with a bifurcate proximal end; sacrum of more than two vertebræ; ischio-pubic symphysis continuous" (p. 29).

The order is divided into three families—I. "*Bidentalia*"; II. "*Cryptodontia*"; and III. "*Endothiodontia*."

The first family includes two genera, *Dicynodon* and *Ptychognathus*. The second family includes the genera *Oudenodon*, *Theriognathus*, and *Kistecephalus*. The third family is represented by the truly singular genus *Endothiodon*, in one species of which, viz. *Endothiodon bathystoma*, the author points out certain marks of affinity to the European Triassic genus *Placodus*, and intimates that further knowledge of the skeleton of *Endothiodon* may lead to its removal from the *Anomodontia*, to the advantage of the more natural character of that order.

As the order is defined in the Catalogue, it includes thirty-four species, represented by sixty-five specimens, some of which indicate reptiles of considerable bulk.

In the order *Dinosauria* a "Section" is represented by twenty-nine fossils referred to the genera *Tapinocephalus* and *Pareiasaurus*, characterized by the peculiar modification of the vertebræ described by the author in the 'Quarterly Journal of the Geological Society,' vol. xxxii. p. 43, pls. iv. & v., suggesting the term "*Tretospondylia*" applied by him to this Section of great herbivorous reptiles.

To the order *Labyrinthodontia* are referred the genera *Petrophryne* and *Saurosternon*, Huxley, to which latter fossil the name *Batrachosaurus* (bespoke by Fitzinger) had been given by its discoverer Mr. A. G. Bain.

The following is an extract from the Preface, in which the Author, with other topics, discusses the probable geological age of the South-African formations from which these new and singular reptilian fossils have been derived.

"From the observations of Andrew Geddes Bain* and his fellow explorers † of the geology of the Cape, we learn that, before the continent of Africa, as it now is, existed, the animals which have afforded the subjects of the present Catalogue lived, died, and propagated their kinds, through untold generations, in and near a vast body of fresh water occupying an extensive tract now elevated into mountain-ranges, attaining, *e. g.* in the Drakensberg range, an altitude of upwards of 11,000 feet. In the preexisting lakes or estuaries these dragons (*Reptilia*) frequented the banks and waters; and many of their carcasses sank and rotted in its sediments. Some notion may be formed of the duration of this life-scene by the ascertained vertical thickness of the fossiliferous lacustrine deposits in the following richly productive localities:—Stormberg beds, 1800

"* 'Geological Transactions,' second ser., vol. vii. 4to, 1845–1856, p. 53; and 'Geology of South Africa,' a lecture delivered by A. G. Bain, Esq., at the General Institute, Graham's Town ('Eastern-Province Monthly Magazine,' vol. i. p. 396).

"† Joseph Millard Orpen, Esq., Government Surveyor of the Cape of Good Hope; Charles E. H. Orpen, M.D.; Dr. Atherstone. See also 'Section of the Zuurberg,' by R. N. Rubidge, Esq., M.B. ('Eastern-Province Monthly Magazine,' vol. i. p. 187)."

feet; Beaufort beds, 1700 feet; Koonap beds, 1500 feet; Karoo shale, or Upper Ecca beds, 1200 feet.

"Actual Africa, in latitudes north of the Cape, still shows fresh-water lakes surpassing in extent those of other continents; but the chief lake-basin of the ancient continent, part of which is represented by these reptiliferous deposits at the Cape of Good Hope, much exceeded in extent Tanganyika, or any of the inland freshwater seas which have been discovered by recent explorers.

"The attempt to conceive or give intelligible utterance to the sense of past time since the reptiles of South Africa existed in the now upraised lacustrine or estuarine area becomes oppressive; the terms in which we reckon up phases of the world's history in connexion with human existence are wholly inadequate to convey a clear or comprehensible idea thereof. We are driven, in the endeavour to realize a conception of prehistoric time, to resort to an artifice akin to that to which the astronomer has been compelled in order to conceive for himself, and convey to others, the relations of space which his instruments and calculus have discovered.

"The multiplication of millions of miles leaves as vague an idea of remoteness of our planet from the nearest fixed star as the multiplication of millions of years expresses the conviction of the geologist as to the periods needed for the deposit of the thousands of remaining vertical feet of stratified sediment composing even a small subdivision of any of his great natural groups or systems of formations.

"The ascertained velocity of light yielded the astronomer a more simple, more graspable expression of comparative distances. Light traverses the diameter of the earth's orbit in a quarter of an hour; it moves at a velocity of 193,000 miles in a second of time. From the nearest fixed star, *a Centauri*, a ray of light takes three years to reach the earth; from Sirius sixteen years. A nebula, near or bright enough to enable the photographer to secure a recognizable image of it, exerts for the purpose a form of force, or sends its ray of light, which probably takes six hundred years in reaching and affecting the instrument and the optic nerve of the human artist. Hence the convenience of defining cosmical spaces or distances in the terms of 'light-years.'

"So with the geologist: having approximately estimated the period required for the formation of a constituent of the quaternary, tertiary, or other period, he substitutes, for numerical aggregates of historical years, the expression that such or such an organism existed and became extinct in such or such a formation—prior, *e. g.*, to the Liassic period, as in the case of the Dicynodont reptiles. The name of the formation gives to him an idea of the distance of time since these and other subjects of the present Catalogue lived, more intelligible than could any row of figures summing up estimates founded on observations of the rates of deposit, of wear, of elevation, or of depression of the several strata of the earth's crust.

"What the geologist requires in order to receive, in these terms,

the solution of his question as to the period of existence of the South-African reptiles, is the evidence of the age of the formations in which their remains became fossilized. The grounds on which geology founds its conclusion of such age in relation to the 'Karoo series' of South Africa, as of the contemporary Panchét beds of India, will be found in the works cited below*. Every specimen described in the present Catalogue, of which the locality has been determined, has come from the divisions of that series known as the 'Beaufort' and 'Stormberg beds.' The latter are the later. But amongst the rich abundance of fossil vegetation in these lacustrine deposits not one example of a cycadeous plant, or other indication of a liassic or oolitic age, has accompanied the vertebrate fossils. The remains of *Glossopteris* are of a species (*Gl. Browneana*) which has never been met with, like the Cycads, in a formation of oolitic age, but is associated in India and Australia, as in South Africa, with palæozoic evidences.

"The question lies between the triassic and the upper carboniferous periods; but the more generally adopted reference of the Beaufort beds and, especially, the Stormberg beds to a triassic age has been provisionally assigned in the notices of the localities in this Catalogue.

"The determination of the batrachian double condyle in the *Petrophryne* (S. A. 118) from the reddish sandstone of the Tafelberg in the Queenstown district proved its Labyrinthodont affinities, which were indicated by other cranial structures, as a similar demonstration in the *Brachiops* † had previously determined the presence of a Labyrinthodont reptile in the Mángali formations of the Kamthi group in India. Fragmentary evidences, most probably Labyrinthodont, and indubitable fossils of a Dicynodont, concur, with the plant fossils, to show the geological correspondence of the Panchét and Kamthi groups in India with the Beaufort beds in South Africa.

"Among the considerations which weigh towards the palæozoic age is the arrest of vertebral development, or retention of embryonal characters, in the centrum of these South-African Reptilia, a cha-

"* Bain and Atherstone, *ut suprà*. Sutherland, Dr. P. C., 'Notes on the Geology of Natal, South Africa,' Quarterly Journal of the Geological Society, vol. xi. p. 465. Rubidge, Dr. R. N., 'On some Points in the Geology of South Africa,' Quart. Journ. Geol. Soc. vol. xv. p. 195. Stow, C. W., Esq., and Huxley, Prof., 'On some Fossils from South Africa,' *ib.* vol. xv. pp. 193, 555, 642. Tate, R., Esq., 'On some Secondary Fossils from South Africa,' Quart. Journ. Geol. Soc. vol. xxiii. p. 139. Griesbach, Charles Ludolf, Esq., 'On the Geology of Natal,' Quart. Journ. Geol. Soc. vol. xxvii. p. 53. Oldham, Thos., LL.D. &c., 'Memoirs of the Geological Survey of India,' 4to. Huxley, Prof., 'On Vertebrate Fossils from the Panchét Rocks, in the above 'Memoirs,' 4to, 1865. Blanford, H. F., Esq., 'On the Age and Correlations of the Plant-bearing Series of India,' Quart. Journ. Geol. Soc. vol. xxxi. p. 519.

"† Owen, Prof., 'Description of a Cranium of a Labyrinthodont Reptile from Mángali, Central India,' Quart. Journ. Geol. Soc. vol. xi. p. 37."

QUATERNARY or PSYCHOZOIC.

Turbary.
Shell Marl.
Old-valley Drift.
Brick-Earth. (Bone-Caves.)
Glacial Drift.

Pleistocene.

MAN.

by Remains.

by Weapons.

Norwich and Red Coralline } Crag.

Pliocene.

MAMMALS under present geographical distribution.

Equus.

TERTIARY or NEOZOIC.

Faluns.

Miocene.

Quadrumana.
Proboscidia.

Mollasse.

Hipparion.

Birds, Orders of.

Orders of Placentalia.

Gypsum &c.

Eocene.

Palæotherium. Rodentia.

London } Clays.
Woolwich }

Toothed Birds. Carnivora.

SECONDARY or MESOZOIC.

Maestricht.
Upper Chalk.
Lower Chalk.

Cretaceous.

Cycloid } Fishes.
Ctenoid }

Upper Greensand and Gault.

Procœlian Crocodiles.

Lower Greensand.

Toothed Birds and Pterodactyles.

Weald Clay.
Hastings Sand.

Wealden.

Iguanodon.

Purbeck Beds.

Spalacothere, and other pouched Mammals.

Portlandian and Kimmeridgian. U.

Pliosaurus, Omosaurus.

Oxfordian. U.

Kellovian. U.

AVES, by Bones and Feathers.

Forest Marble. M.
Bath-Stone. M.

Oolite.

Stonesfield Slate. M.

MARSUPIALS: Amphithere &c.

Lower Oolite. L.

Homocercal Ganoids.

Lias. L.

Ichthyopterygia. Cephalopods (2-gilled).

Bone Bed.

Keuper.
Muschelkalk.
Muschelkalk.

Trias.

Tretospondylia.
Theriodontia. } S. Afr. Reptilia.
Anomodontia. }

PRIMARY or PALÆOZOIC.

Marl and Sand.
Magnesian Limestone.
Red Sandstone.

Permian.

Labyrinthodontia.

Coal-Measures.
Mountain Limestone.
Carboniferous Slate.

Carboniferous.

AMPHIBIA, Ganocephala.

U. Old Red Sandstone.
Caithness Flags.
L. Old Red Sandstone.

Devonian.

PISCES { ganoid. placo-ganoid. placoid. }

Heterocercal.

Ludlow.
Wenlock.
Llandovery and Caradoc.
Llandeilo.
Lingula Flags.
Cambrian.

Silurian.

Echinodermus.
Annelides.
Bivalves.
Trilobites.
Pteropods.
Brachiopods.
Gastropods.
Cephalopods (4-gilled).

Brachiopods. Trilobites. Fucoids. Zoophytes.

racter which is exceptional in liasso-jurassic Reptilia; and that exception, exemplified in *Ichthyosaurus*, is adaptive, as in fishes, in relation to an aquatic medium of life and locomotion. In those South-African Reptilia which, from their jaws and dentition, were herbivorous, and, from what is known of their limbs, more terrestrial than aquatic, the proportion of the primitive notochord retained in their vertebral column, indicated by the term Tretospondylia (Nos. S. A. 1–31), offers a closer analogy to the condition of that column in the early air-breathing Vertebrates of the Carboniferous series than to any Dinosaur of the Mesozoic formations.

"A specimen of fossil fish (*Hypterus Bainii*, Ow.), transmitted with reptilian remains from the Beaufort beds at 'Alice,' near Fort Beaufort, belongs to a heterocercal genus near akin to *Amblypterus*, with close relations to other Ganoids of the Carboniferous formations.

"The answer, then, to the question of the geologist as to the age of the South-African Reptilia, at the present phase of evidence, is, that they are not later in time than the Trias, and probably lived in the Palæozoic period.

"Those, however, to whom such reply is in any degree intelligible form but a small proportion of the numbers visiting the British Museum who may give an intelligent glance at these singular fossils, and more or less comprehend the facts and deductions by which creatures so long extinct have been restored, so far, at least, as to enable the naturalist to assign to them their place and affinities in the zoological system. By such visitors the question naturally asked is, 'When did these dragons live? and how long ago is it since they died out?'

"To assist the comprehension of the grounds of a reply a 'Tabular View of the Fossiliferous Strata,' in the order of superposition, is subjoined (see opposite).

"Among the most recent of these strata (viz. the turbary deposits, or accumulations of peat, still in course of formation) there are found evidences of Man, with remains of red-deer, roebuck, wild boar, the small indigenous ox (*Bos longifrons*), &c.; but the conditions under which the great vertical extent of these deposits have been accumulated in certain localities yield ground for an estimate of a considerable lapse of historical time.

"When such beds of peat have been dug out, they are seen, in many localities, *e. g.* in Ireland, the Isle of Man, and adjacent coast of England, to have rested on a deposit of white marl, of a fine tenacious consistency, and forming a good manure for oat- and potato-crops, due, in part, to remains of successive generations of freshwater mollusks which flourished in the ancient lakes of which the marl formed the bed. In this marl are found remains of the reindeer, the *Megaceros*, the hairy northern elephant (*E. primigenius*), and of other large extinct beasts, which roamed from Northern Europe over a land extending into the Atlantic, parts of which continent now remain in an insulated state, as 'Great Britain, 'Ireland,' the 'Isle of Man.'

"Since the deposits of 'shell-marl,' and of the corresponding